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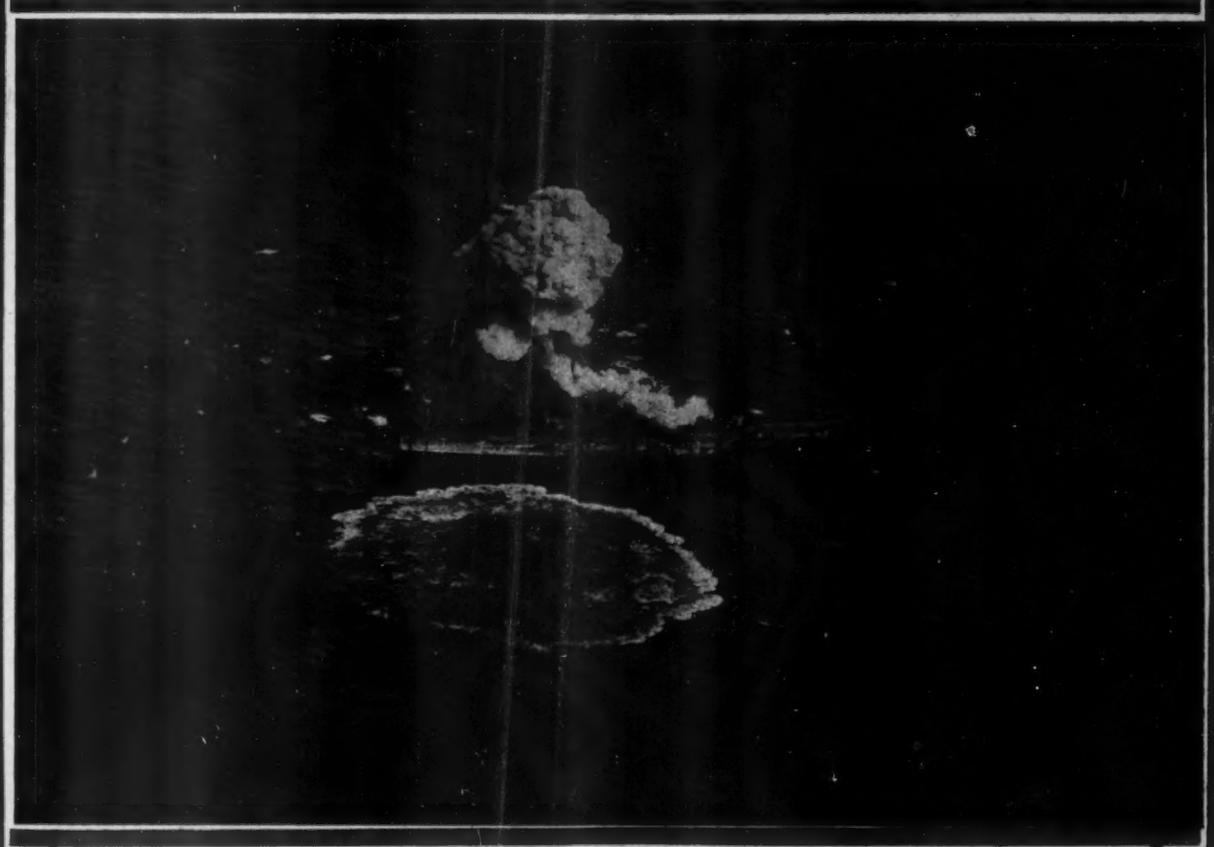
FILE

# AVIATION AND AIRCRAFT JOURNAL



An 1100 lb. Army Bomb Hitting the Ostfriesland

VOLUME XI
Number 6

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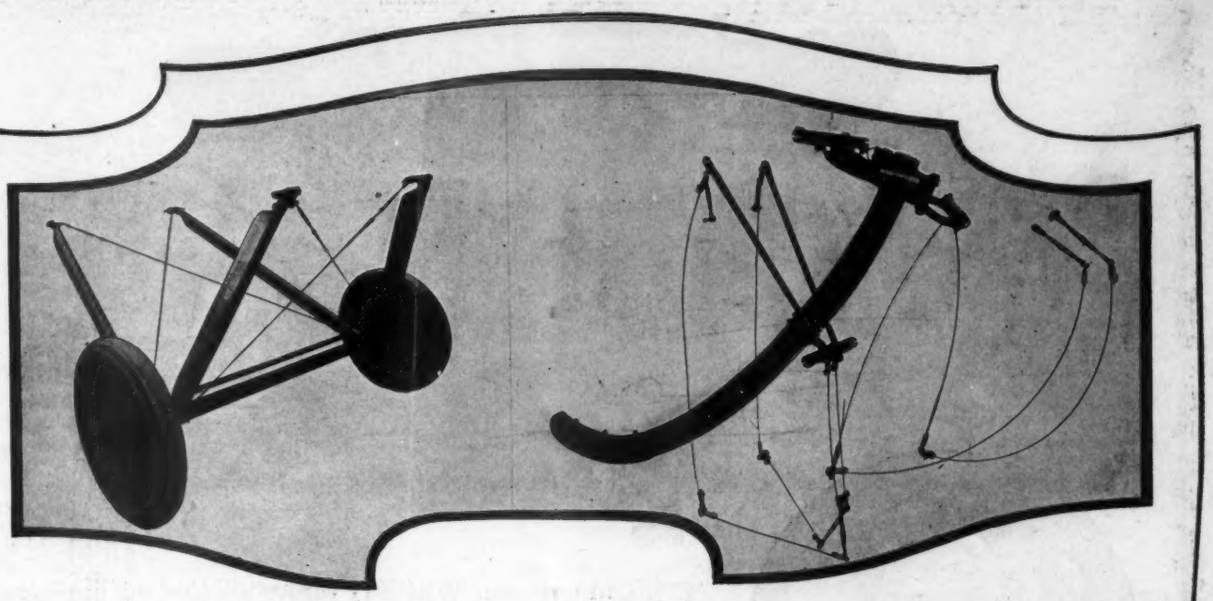

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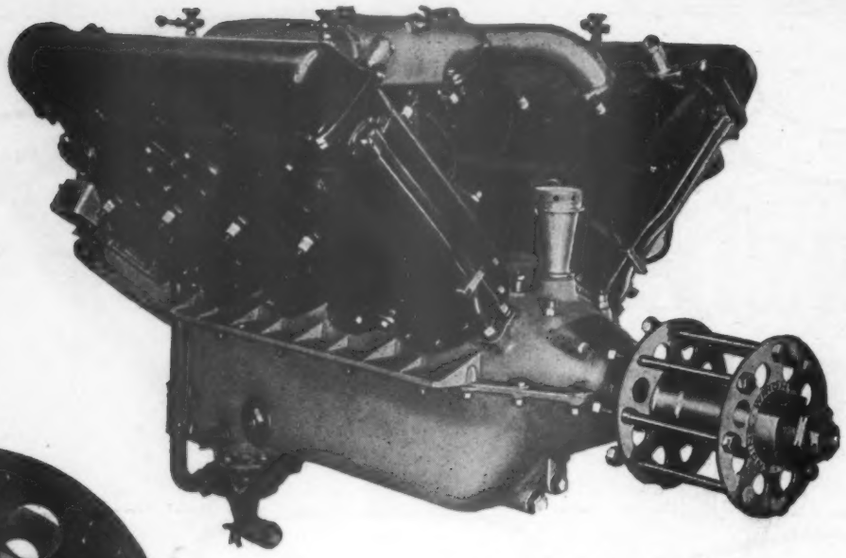

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# AVIATION
AND
# AIRCRAFT JOURNAL

AUGUST 8, 1921 VOL. XI. NO. 6

*Member of the Audit Bureau of Circulations*


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*Thomas-Morse Training 2-Seater in flight over Ithaca, N. Y.*

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# AVIATION AND AIRCRAFT JOURNAL

LADISLAS D'ORCY, EDITOR
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Vol. XI AUGUST 8, 1921 No. 6

## Wind Tunnel Testing

THE laws of similitude are understood in full by only a few of those who use results of model experiments. No engineer, however, can help feeling suspicious of the attempt to extend to full scale full speed conditions of results of tests on 18 in. models at a speed of 25 m.p.h. To satisfy student and practical man alike, the wind tunnel must in some way be brought closer to actual conditions.

The two obvious methods of approaching reality with model experiment are to increase the speed and to increase the scale, and each of these methods has been practiced, the first having been most enthusiastically advocated in America, the second in England and Germany.

It is easy to reach the full speed of flight, but it is impossible to approach anywhere near to the full size, and a test cannot be made in the neighborhood of the true conditions except with a tunnel of enormous size and a prohibitive expenditure of power. Other methods are now being suggested.

The most consipcuous recently advocated have been the use of a compressed air tunnel, suggested by Dr. Munk, and the employment of carbon dioxide as a test fluid as advocated by M. Margoulis. However these schemes may prove to work, it is encouraging to note decided trend toward the elimination of scale corrections by a closer approximation to true flight conditions in the laboratory. Results obtained in large and high-powered wind tunnels, when skillfully interpreted in the light of full-flight test results will bring airplane design even nearer to being an exact science than it is at present and will make it still more possible for the designer to predict performance with accuracy before the construction of a machine is undertaken. We are glad to observe in this connection that a 10-ft. tunnel is already projected for immediate construction in the United States and that one 7½ ft. in diameter and another 5 ft. in diameter, the latter intended to give a speed of approximately 180 m.p.h., are actually started, and that all these tunnels are of original design, not copied from any European example.

## Admiral Moffett

THE first American Air Admiral is now organizing the new Bureau of Aeronautics of the Navy. For several years those of the public interested in aviation and in a position to know its needs have advocated having an officer with the rank of Rear Admiral placed in command of the unified air activities of the Navy. Opinion that carries weight is unanimous in its approval of the appointment of the present head of Naval Aviation. His brilliant record at the Great Lakes Station will, it is predicted, be repeated in his work of directing aviation in the Navy at which work he will have plenty of scope to exercise the remarkable administrative ability he possesses, and which manifests itself in direct proportion to the size of the job it is brought into play against.

## Our Aeriel Photographers

MUCH well-earned praise is due the pilots and observers of the aircraft which carried out the recent bombing tests. Few of those who witnessed the tests, let alone the great public at large, realized that the burst of every bomb dropped had to be photographed. Army and Navy photographers in airplanes, seaplanes, and dirigibles did this work, and did it in such a manner as to reflect the highest credit on their training and ability. As the pictures were taken from an altitude much lower than that at which the bombing machines were flying the work of the photographers, in addition to being considered every bit as important as that of the bombers, may also be considered as dangerous. The concussion from the bomb explosions was distinctly felt by the photographers each time they flew over the target to photograph a burst. In addition to this some of the photographers were flying out over water on land machines some days as long as five hours at a stretch. The permanent records, of the tests, in the form of pictures, will be valuable for showing to congress, and later to the country at large, the hits and the consequent damage done to the various targets during the tests.

## The Pulitzer Race

THE postponement of the Pulitzer Race is greatly to be regretted both by those who were to have participated and by all who have the interests of aviation at heart.

The Gordon Bennett Race and the British Aerial Derby are firmly established as speed classics of the air. That the Pulitzer Race should be necessarily postponed at a time when it too was becoming firmly established is all the more regrettable.

Lack of entries from the services is given as the cause of the postponement. While it may be difficult to understand why these machines cannot enter it is as well to rest assured that good reasons exist for the orders which prevent them. After all, the propriety of service pilots and machines competing in a race under private auspices with civilian pilots and machines is open to question.

However, the contention that purely speed races serve no useful end is not justified. Such a race when properly conducted impresses the public tremendously both by the performance of the entries and by the manner in which the affair is handled. Also such a race in peace time is an incentive for the development of the types of machines and engines which will be vitally necessary in war time.

We hope that the race will take place next year as scheduled and will be conducted in such a manner and contain such performances as to make the delay seem justified.

# Bombing Raid on Eastern Cities

*Sham Attacks for Practice on New York, Washington, and Other Cities*

To study further the problems of air attacks, Brig. Gen. Wm. Mitchell ordered the 1st Air Brigade stationed at Langley Field to make a theoretical bomb raid on severel Eastern cities. To take advantage of an assumed destruction of a defending fleet, a general situation was presented for solution.

War was declared between the United States (Blue) and a North European Power (Red) on July 15th. On July 21st, the two hostile forces encountered each other at a point 75 miles east of the mouth of Chesapeake Bay. The only aircraft with the Blue Navy were seaplanes, and unarmed training planes used for observation of gunfire. With the Reds were 6 airplane carriers, as follows: One, carrying the 1st Pursuit Group of 100 planes; Two, carrying the 2nd Pursuit Group of 100 planes; Three, carrying the 14th (Heavy) Bombing Squadron of 25 planes; Four, carrying the 15th (Heavy) Bombing Squadron of 25 planes; Five, carrying the 16th (Heavy) Bombing Squadron; Six, carrying the 17th (Ground Attack) Squadron. While the two hostile forces were still 100 miles apart, planes from One quickly shot down the Blue seaplanes and turret planes. This was followed by an attack by the entire Red air force on the Blue fleet. The latter fell an easy prey to the bombing planes, which took off from the carriers, who had now approached to within 25 miles of the Blue fleet. At 12:40 p.m. the last of the Blue battleships, the Eastfreeland, turned turtle and sank in 50 fathoms.

The day following, the 22nd, the Reds, landed from the carriers at a point 8 miles north of Cape Hatteras, where an airdrome was established, on which were landed immediately the 1st Pursuit Group and the 15th Bombing Squadron. This airdrome was situated on an uninhabited sandy strip of land, 40 miles long, separated by 30 miles of water from the mainland. Entrance to this body of water could be made by deep inlets at either extremity of the narrow island. Operating from this airdrome, bombing attacks were made the night of the 22nd which destroyed all planes on the Blue airdrome at Langley Field and the Norfolk Navy Yard. This effectually precluded any interference with the Red airdrome by land or sea forces, and the sole remaining Blue air forces within striking distance were a few observation and training planes at Bolling Field and at Mitchel Field.

The night of the 23rd, Richmond was attacked with gas, high explosive, and incendiary bombs with great loss of life. More than half of the city burned down. On succeeding nights, similiar attacks were made on Newport News, Norfolk, and the neighboring towns with similar results. On the 27th, Red observation airplanes reported the entire peninsula between the York and James deserted. Roads running south and west from Norfolk and Richmond were reported crowded with refugees. Red attack airplanes landed at Langley Field and found the entire vicinity deserted: this field was employed thereafter as an advanced airdrome. A daylight attack was made on Philadelphia on the 28th, with results equalling those previously obtained.

On July 27 the Red Commander-in-Chief ordered air attacks to be made on Washington and on New York on July 29.

Following the plan as developed from the general situation, orders were issued which would carry out the attack. The field orders specifically stated the situation to the Brigade. They were in part as follows:

Strong enemy land forces (Blue) now hold Washington, Philadelphia, and New York, with a line of communications held by land units between these points. Our own air forces (Red) hold Bodies Island and Langley Field. As a result of night bombing attacks, Richmond and the entire peninsula between York and James Rivers are reported by our observation planes to be deserted, with all roads running out of the peninsula crowded with refugees. The Blue air force is practically negligible. A few observation and training planes are reported at Bolling and Mitchel Fields. The air forces (Red) represented by the 1st Provisional Air Brigade, will attack Washington and New York July 29.

The First Pursuit Group (Capt. B. V. Baucom) (represented by the 1st Provisional Pursuit Squadron) will take-off at Langley Field at 8:00 a.m. July 29 and cover the movement of our bombing and attack units on Washington. Upon arrival at Washington, it will attack (simulated) the city with our bombing and attack units. Upon completion of attack, it will proceed to Bolling Field, where it will participate with Flight "A", 17th Ground Attack Squadron in an attack (simulated) on the airdrome. All roads in the vicinity of Bolling Field will be cleared of enemy troops. The 15th Heavy Bombing Squadron (Major Leo Walton) (represented by the 1st Provisional Bombing Group) will take-off at Langley Field at 8:05 a.m. July 29, and proceed to Washington. Upon arrival at that point, it will attack (simulated) the city with heavy demolition bombs. Upon completion of this attack, it will proceed to Bolling Field and participate with our attack and pursuit units in an attack (simulated) upon the airdrome. It will land at Bolling Field after our attack flight has landed and await further orders. Flight "A", 16th Heavy Bombing Squadron (imaginary), will take-off at Langley Field at 8:30 a.m. July 29, and proceed in formation to Bolling Field. Upon arrival at that point, it will land and set up replacement and service stations for our pursuit and heavy bombing units. It will carry supplies, rations, replacements, gasoline and oil for our air forces engaged in the attack upon Washington.

Flight "A", 17th Ground Attack Squadron, (imaginary) will take-off at Langley Field at 8:10 July 29, and proceed to Washington. Upon arrival at that point, it will participate with the pursuit and heavy bombing units in an attack (simulated) upon Bolling Field. Upon the completion of this (simulated) attack, it will land, seize and hold the airdromes as a base for our pursuit and heavy bombing units. It will hold Bolling Field until further orders.

Second Pursuit Group (imaginary) will take-off at Langley Field at 7:45 a.m. July 29, and cover the movement of our heavy bombing and attack units to New York. Upon arrival at that point, it will participate with our bombing and attack units in an attack (simulated) upon the city. Upon completion of this attack, it will proceed to Mitchel Field and participate with our ground attack flight in an attack (simulated) on the airdrome. All roads in the vicinity of Mitchel Field will be cleared of enemy troops.

The 14th Heavy Bombing Squadron (Major T. J. Hamley) will take-off at Langley Field at 8:00 a.m. July 29, and proceed to New York. Upon arrival at that point, it will attack the city with gas and heavy demolition bombs. Upon the completion of this attack, it will proceed to Mitchel Field, land, and await further orders.

Flight "B", 16th Heavy Bombing Squadron (imaginary) will take-off at Langley Field at 8:30 a.m. July 29, proceed to Mitchel Field. Upon arrival at that point it will land and set up replacement and service station for pursuit and heavy bombing units. It will carry supplies, rations, replacements, gasoline and oil for our air forces engaged in the attack upon New York.

Flight "B", 17th Ground Attack Squadron (imaginary), will take-off at Langley Field at 8:15 a.m. July 29, and proceed to New York. Upon arrival at that point, it will participate with the pursuit and heavy bombing units in an attack (simulated) on Mitchel Field. Upon completion of this (simulated) attack, it will land, seize and hold Mitchel Field as a base for our pursuit and heavy bombing units. It will hold Mitchel Field until further orders.

First Photographic Section (First Provisional Photographic Section) will have sufficient airplanes, properly equipped with personnel and both moving and still cameras to secure photographs and moving pictures of the simulated attack upon Washington, by our pursuit and bombing units. It will accompany these units to Washington and upon completion of the simulated attack, will land at Bolling Field and await further orders.

Second Photographic Section (First Provisional Photographic Section) will have sufficient airplanes properly equipped with personnel and both moving and still cameras to secure photographs and moving pictures of the simulated attack upon New York, by our pursuit and bombing units. It will accompany these units to New York and upon completion of the simulated attack, will land at Mitchel Field, Long Island, and await further orders.

The fifteen Martin Bombers, one Handley Page, one Caproni, two Thomas Morse scouts, and two DH4's left Langley Field on July 29 for New York at the time ordered and flying through a low haze all the way arrived over New York at noon, Eastern time. The city was attacked by gas, incendiary and fragmentation bombs after which the command landed at Mitchel Field. Brig. Gen. Mitchell accompanied by his aid St. Clair Street commanded the attack.

The squadron of bombers commanded by Major Leo Walton proceeded to Washington and after attacking the city landed at Bolling Field.

On Monday August 1, the maneuver was continued by the squadrons flying from New York to Philadelphia, Wilmington and Baltimore and then to their base at Langley Field.

On the arrival of the squadron at Mitchel Field, Glenn L. Martin entertained the seventy pilots and observers at lunch at the Garden City Hotel.

## Aviation in the Argentine

Aviation activity in the Argentine is increasing steadily both in the capital and in the provinces. Several shipments of airplanes have recently come into the country and more are on the way. The new machines will be used in school work and in the development of flying services between cities in the interior.

Airplanes having arrived in the country since March together with their owners are as follows: The military aviation school of El Palomar, 15 Italian S.V.A. machines with 220 hp. S.P.A. engines, and 20 Avros of the standard training type. This school uses these types of machines for the instruction of its 40 pupils. The Direction of Aeronautics, 36 Caudron machines obtained in Italy at reduced prices, for use in civil aviation. The school of flying at San Isidro, 14 Curtiss JN machines with 90 hp. engines, for instructional purposes. Handley Page, 20 machines made up of Bristol, Armstrong, and Avro types. M. Guichard who was a technical director in the now defunct French Argentine Air Transport Co., 25 machines of the Spad-Herbemont, Potez, and A.R. types for use among various civil aviation firms. The two British companies, The River Plate Aviation Co. and the Anglo-Argentine Aviation Co. have also received shipments of various types.

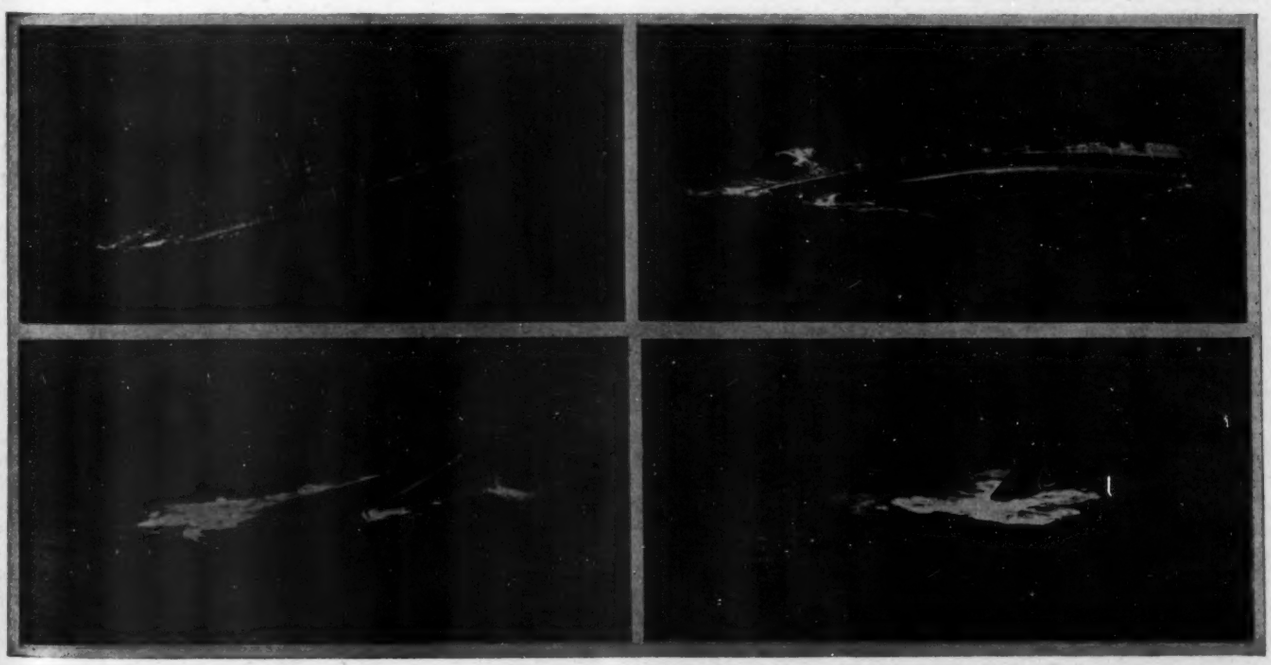
The number and variety of the different types of machines received in the country speaks well for the future of commercial aviation.—*Aeronautics.*

## Newspapers by Airplane

The Oregon, Washington and Idaho Airplane Co. carry the Oregon Journal from Portland to Seaside and Astoria daily. The machine used is a Curtiss Seagull with an F-boat in reserve. Approximately 300 to 400 lb. of papers and one passenger are carried on the out trip, and two passengers on the return. The machines leave the river in the heart of Portland at 1:30 p. m. and fly west over the city to the sea where the Columbia River is followed to Astoria. Papers are unloaded there for that city and the north beaches after which the machine takes-off for Seaside. The total distance is 120 miles which is covered in 1 hr. 35 min. down and 1 hr. 15 min. returning, with the prevailing winds. The service is maintained despite the weather, and as a result the Oregon Journal is on sale in Astoria and Seaside several hours before other papers.

## Aviation Day at Seymour, Ind.

The establishment of the Western Airline Co.'s engineering division at Seymour, Indiana, was the occasion of a celebration of 'Aviation Day" at that place on July 8th. This event was held under the auspices of the Seymour Chamber of Commerce, and those from out of town who assisted were Major Longanecker and Lieut. Charles McK. Robinson, of Fort Benjamin Harrison, Ind., W. M. Flagley, Secretary of the Curtiss Indiana Co., of Kokomo, Ind., and W. S. Sanders, Secretary of the Indianapolis Aero Association. Flights over the city were made in the afternoon. The evening program was held in Schneck Park and plans were formulated for an aviation meet to be held late this fall. Addresses on aviation and its possibilities were made by prominent citizens of the city and officials of the Western Airline Co.



How the Ostfriesland Sunk

*U. S. Navy Official Photograph*

# A New Type of Wind Tunnel *

By Max Munk

The difficulties involved in conducting tests on airplanes and airships in actual flight, difficulties greater in the early years of aviation than now, and the matter of expense also, induced investigators to seek for information through tests upon models. The first of such tests was made by moving the model through stationary air either by means of a whirling arm or in a straight line. Later the method adopted was to suspend the model in a current of air flowing in a large tube. Wind tunnels of this type have become of increasingly great importance. At first the tunnels were only small pieces of physical apparatus in a laboratory, but at last they require an entire building. The latest wind tunnel of the Zeppelin Company in Germany provides a current of air ten feet in diameter, which has a velocity of 110 m.p.h. and absorbs 500 hp.

The results obtained with this type of wind tunnel are of very great value and at the present time they are the chief source of information for the aircraft designer. However, there are certain critics who declare that the results of wind tunnel tests are valueless for purposes of design. Indeed, justification for such opinions is not wholly lacking. There is, in fact, no necessary and exact connection between the motion of air around a small airplane model and that around the full-sized airplane. Sometimes the results of the tests on models agree well with those observed with the airplane itself; but important cases are known where the two do not agree. Further, there are questions the answers to which it is most important for the designer to have, and yet the answer deduced from tests of models in wind tunnels would be absolutely wrong. There is always an uncertainty connected with such tests, because one is never quite sure whether or not the results thus obtained may be applied to full-sized bodies.

In spite of this uncertainty, wind tunnels have been of the greatest use in the development of aeronautics. Tests upon models led to the construction of streamlined bodies having small resistance, and of aerofoils of good section. Experiments in wind tunnels led to the discovery of the theorems referring to the lift of aerofoils and to the effect of combining several aerofoils. A wind tunnel is still the most important means available for scientific tests. It cannot be denied, however, that it is becoming more and more difficult to find a problem suitable for study by a wind tunnel, which can be immediately applied in aeronautics. Many tests of a theoretical character can be suggested, but it is difficult to interpret them. There are important and urgent tests with respect to the design of aircraft which should be performed; but the results would be worthless if they were carried out in a wind tunnel of the present type. The theory of non-viscous motion is almost complete; the tests referring to it have been made, and the field of investigation lying between non-viscous motion and actual motion in the air is cultivated so intensely that it is difficult to find a new problem.

### *Use of Compressed Air*

For all these reasons, the author believes that his proposition to make use of compressed air in a new type of wind tunnel comes at the right moment. Tests in such a tunnel will give information concerning those questions which could not be investigated with the present tunnels because of the exaggerated effect of viscosity. The new type of tunnel is free of the uncertainty characteristic of the older type, and will indicate clearly what problems may be undertaken with the latter. It will make unnecessary many full-flight tests, and will mark a step in advance in aeronautics.

Let us then consider this new type of wind tunnel; its advantages, the difficulties attendant upon its use, and the special methods required.

The main difference between the new type of wind tunnel and the ones now in operation is the use of a different fluid. The idea is to diminish the effect of viscosity. It would not be surprising if any other fluid were better than air in this respect. However, there does not seem to be such a fluid. Water, the liquid most easily obtained, has, indeed, a comparatively small viscosity; that is, the ratio of its viscosity to its density is only the thirteenth part of the similar ratio for air. The density of water, however, is so great that it is hardly possible to afford the horsepower required to force water through a large tunnel. But, even supposing that such a current of water could be obtained, e.g. by using a natural waterfall, it would be quite impossible to make tests in it. A model could not be made sufficiently strong to withstand the enormous forces acting on it, nor would it be possible to hold the model stationary. The same difficulty would be met in using any other liquid. As for gases other than air, carbonic acid is the only one which has a ratio of viscosity to density less than that of air; but the difference is so small that it would not pay to use it. It is less expensive to build a larger wind tunnel than to construct one for using carbonic acid gas, which has to be sealed and requires tanks and other contrivances for holding the gas; and, further, the difficulties of operation would all be increased.

The fact that there is still another way of changing the fluid, did not occur to any one for many years. Air may be used; but, if it is compressed, it becomes a fluid with new properties, a fluid which is the best suited for reliable and exact tests on models. When air is compressed, its density increases, but its viscosity does not. The increased pressure, it is true, requires strong walls for the tunnel to withstand the pressure and to prevent the air from expanding; but the increase of effectiveness secured for the tests is so great that it will pay to make the necessary changes and to replace the light walls of existing tunnels by heavy steel ones.

### *Value of Wind Tunnel Tests*

Before discussing this point we must first convince ourselves that the increase of pressure greatly increases the range and value of wind tunnel tests.

We are inclined naturally to compare small objects with large ones, with the assumption that all the qualities are independent of the size of the object, and that therefore the effects will be correspondingly smaller or larger. Coming at once to our problem, we are disposed to think that useful information for the designer of a flying machine may be obtained by observing the shapes of a butterfly or of various insects. In fact, this is the idea underlying tests on models. The absolute size of bodies is, it must be noted, a concept devoid of exact meaning. There is no absolute length; the length of any object can only be compared with that of another. Imagine all scales to have been destroyed, and let us not be conscious of the dimensions of our own bodies. Then we would not be able to decide whether our physical world should be called a dwarf one or a giant one—we would have no basis of comparison. We may therefore reasonably expect that a world on a different scale than ours would not differ essentially from ours if the same physical laws are valid in both.

This does not mean that all numerical ratios would be the same in both. It is not necessary that the same physical laws produce the same motion of a fluid, i.e. a geometrically similar motion, around two similar bodies. For the streamlines of a fluid around an immersed solid are not related to its shape by geometrical relations but by those derived from the laws of mechanics. It is possible, however, to derive the condition for obtaining such similar motions by extending our general considerations, without using mathematical processes.

We picture two phenomena, independent of each other; in particular we presuppose that no scale is carried from the seat of one phenomenon to that of the other. We consider separately two geometrically similar solids, each immersed

* An abstract from N.A.C.A. Technical Note No. 60.

in its own fluid and endeavor, under these conditions, to see if we can detect any difference between them.

The two solids being supposed to be similar geometrically, no difference can be found between them, since we do not have a scale. By selecting any particular length of the body, its dimensions can provide us only with a standard length for the investigation of the relation between the body and space-qualities of the fluid.

For the same reason we cannot detect any difference between the densities of the two fluids. Instead of considering density as the second standard unit—length being the first—we will obtain a more useful one and one to which we are more accustomed, if we combine the concepts of volume and of density, and consider, for instance, the mass of a cube of unit volume filled by the fluid as our standard unit of mass.

The velocity of the fluid relative to the immersed body and at a great distance from it may be considered as a third standard unit.

It is essential to realize that it is not possible to find any relation between these three quantities. Neither do any two of them mean the same physical thing, nor can any two of them be combined in such a way that the third appears. If, therefore, the qualities mentioned were sufficient to determine all the features of the phenomenon, the flow around similar bodies would always be similar also; we would not be able to detect any difference. This is the actual case if the fluid is non-viscous, and therefore motions around similar bodies immersed in perfect fluids are similar.

The viscosity of a fluid is characterized as follows: consider a unit cube of the fluid, so chosen that in any plane parallel to one of its faces the fluid has a constant velocity; let the velocity of the fluid increase uniformly as one passes from this face across to the opposite one; then, if this change in velocity equals the unit of velocity, the force of friction on the face of the cube is called the coefficient of viscosity of the fluid. This appears to be a complicated concept, so we shall try to combine it with the two standard units of length and of mass, so that we obtain a velocity characteristic of the viscosity of the fluid, in combination with the other two qualities. Let us imagine now a unit cube of the fluid and any difference of velocity on the two opposite sides. There is a force of friction on each such face. If this force were to act on a unit cube of the fluid, i.e. on a unit mass, it would produce an acceleration, and in the course of being moved through a unit distance this cube would have its velocity increased from 0 to a definite value.

### *Reynold's Velocity*

We may imagine the conditions of velocity on the two opposite faces of the unit cube varied until the force of friction is such that the resulting velocity of the second cube equals the difference in velocity at the two faces of the first cube. Half this velocity may be called the "Reynolds velocity." It is characteristic of the viscosity of a fluid whose density is known, the dimensions of a solid body immersed in it being known, so as to furnish a unit of length. It can be determined for one of the two phenomena considered without reference to the other.

Therefore the ratio of the velocity of a fluid to this Reynolds velocity can be determined without reference to another phenomenon; it is an absolute number, called the Reynolds Number. It may be the same in the case of two phenomena, or it may be different. If it is not the same, here is an essential difference between the phenomena, which may be observed and stated; and it would be most remarkable if, in spite of this difference, the fluids should have the same motions; it would in fact be impossible. But if, on the other hand, the two numbers are equal, we describe the motions of the two fluids as identical, taking viscosity into account, too.

There are still other differences between the tests on models and actual flight, which will cause errors. It is necessary to realize that these, other than the one due to viscosity, do not effect seriously the value of the results of the tests. The new type of wind tunnel may, then, be expected to give reliable results.

The best evidence of the insignifiance of these errors due to other causes is obtained by comparing tests made in different wind tunnels. In the two wind tunnels at Göttingen very careful investigations were made on aerofoils. The results of these tests show that full-sized tests are much better than model ones, and provide the designer with clear, reliable and useful information. It is not sufficient, however, to compare the results of several tests in a perfunctory manner; care must be taken.

The Göttingen tests were not made under conditions geometrically similar; the two tunnels are not equally good. There are many tunnels which have more turbulence than is necessary, the designer having only taken care to obtain a uniform velocity. The older wind tunnel at Göttingen was exceedingly turbulent. The surfaces of the models were different purposely. Only the results obtained in good wind tunnels should be compared, the model having a proper surface, and the test being thoroughly laid out with reference to its influence. Then the differences would be smaller, and the reliability and usefulness of tests would appear more distinctly.

The matter may be considered also from another point of view. The tests show that under particular conditions the results of different tests agree very well; in certain cases only is good agreement lacking. Now it is not evident that the results may be expected to agree. It may be and is very probable that the motions which do not agree with each other are such sensitive motions as were described in the previous section. Of course this sensitiveness appear exaggerated if the differences in the test conditions are.

A deduction is made for other errors; whether the cause be the contrivance used for supporting the model, the turbulence of the air, the variation of pressure or of velocity, or the finite distance of the walls of the tunnel or the boundaries of the current of air, the error is small provided the cause is. Their influence can be made as small as is necessary and customary in any technical test. Not only is the error small, it is regular, it can be compensated for, and it does not impair the comparison of different tests, as would the error due to viscosity.

In a tunnel filled with compressed air it is possible to obtain a range of coefficients much larger than in the tunnels now in use. But the range is limited in several respects, and its features must harmonize with each other in order to secure good results and also a low cost of operation.

The size of the tunnel is limited by the size of the models. It is not possible to make correctly shaped models if they are too small. The velocity of flow, on the other hand, must not be too great, lest the contrivances for supporting the model become so large that they disturb the motion. The stresses in the model must also be considered. This condition is duly respected if the dynamical pressure of the air does not exceed a particular value. Hence the velocity must be smaller, the greater the density. This is desirable also with respect to the power required, to the increase of temperature produced, and to the dimensions of the fan and its shaft. The designer must also consider the time required to fill the tunnel with a compressor of proper dimensions. The pressure is limited only by questions of construction.

The designer, in the first place, must choose the dynamical pressure he can permit without the supports of the model introducing too great an error. If he selects too high a pressure, the diameter must be made greater. Generally this will increase both the cost of operation and other difficulties.

All the quantities are more favorable the higher the pressure. This advantage must be compared with the difficulty of construction in consequence of high pressure, and the disadvantage of a smaller diameter. A theoretical limit for the pressure is the critical point where the air ceases to be a "perfect gas". In the neighborhood of this point the viscosity increases and therefore it is of no advantage to increase the pressure; but reason of construction would prevent this point being reached. The critical point of carbonic acid gas is, however, much lower, especially if it is cooled.

The results of tests in a compressed air wind tunnel would be applied in the same way as is the practice with existing tunnels. The tunnel would give the ordinary coefficients, and the right ones.

The results would be, first of all, for the information of the designer of aircraft, giving him the true values of the coefficient required for any problem. The tunnel could also be used with advantage for scientific investigations.

# The Klemperer Wing-Load Indicator

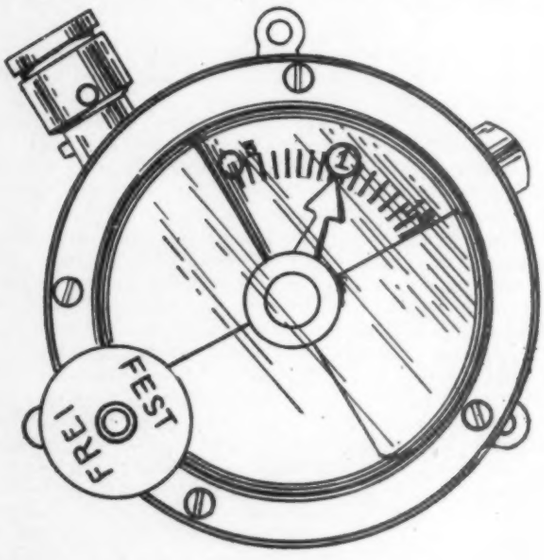
By Leon N. W. Colin, A. E,

A pilot is limited in the maneuverability of an airplane by the strength limit of the airplane. To go beyond this limit is to break the weight carrying members.

Pilots have had no guide by which they could judge the wing stress in its approach towards the ultimate stress. They have relied on touch. During flight the stress to which the airplane is subjected fluctuates constantly. The existence of these fluctuations in stress are recognized without knowledge of their value. However, the ultimate breaking stress of the weight-carrying members in airplanes is known and from this arises the usefulness of a device which will tell the pilot the extent of the stress on the lift surfaces. And this enables him to know the degree of safety which exists. The Klemperer Wing Load is such a device.

Every pilot knows from experience the variability of the centrifugal force during the course of a flight. He knows that on making sharp turns, climbs, and on pulling out of a dive, how he is forced upon, or lifted from, his seat. The lift surfaces of the airplane must be so constructed as to withstand this stress. Without an instrument the pilot can have no knowledge of the extent of the forces exerted on the lift structure. Just how far he may be able to go during maneuvers without mishap he cannot tell with certainty.

Many pilots are prejudiced against instruments. They claim that there are already too many. This opinion betrays




KLEMPERER WING LOAD INDICATOR

a lack of understanding of the purpose of instruments which is to serve as a guide to the pilot when necessary. The Wing Load Indicator, in particular, does not require the constant attention of the pilot. This instrument is intended to serve as an indicator for the pilot in special maneuvers.

The wing load indicator has a diameter of 2¾ in.; it weighs 10.58 oz. and is as simple to install as a clock. It is evident therefore, that objection to this device cannot be taken on a basis of excess space and weight or difficulty of installation. The indicator is installed on the instrument board or on the fuselage, behind the wind shield. It indicates the rise or fall of the wind load above or below the straight horizontal flight load value. If the indicator shows 2 it means that the weight carrying members are bearing, on the average, twice the load of normal flight. When the airplane has a safety factor of 5 and the indicator points to 2, then the pilot has a safety margin of 3. When the indicator shows 5, then the strength limit of the airplane has been reached.

During normal horizontal flight the indicator points to 1, which means that the airplane has the normal, mathematically determined aerodynamic load.

If the airplane be underloaded or overloaded, then in horizontal flight the indicator will show a value respectively less or more than 1, and will have a corresponding safety factor. The breaking point will, for example, be at 5.5 when underloaded or at 4.5 when overloaded. In sharp turns during which the supporting surfaces must bear the centrifugal force in addition to the weight, further stress is put on the structure. For example, on a horizontal turn with a 45 deg. bank and without loss of altitude the indicator will point from 1.6 to 2 or more. The indicator remains at this point as long as the turn is made without loss of speed. If the turn becomes sharper, the needle will immediately point to a higher value, and vice-versa, will point to a lower value when the turn becomes flatter. During a turn, increase or decrease in altitude will respectively increase or decrease the load factor. The load factor increases when the airplane is suddenly pulled up from horizontal flight, but decreases as soon as the speed reduces in the climb. While pulling out of a glide the indicator fluctuates between 1.3 and 1.5. During sudden climb, there is a double or even greater strain on the structure. During climbing turns, especially after a dive, the highest loads exist, and it is possible to reach the breaking point. During a climb the stress is less than during horizontal flight because part of the weight is carried by the propeller thrust. Normally the safety load is between 0.8 and 0.9. During a glide with engine on the stress is also somewhat less than during normal horizontal flight, the needle pointing approximately to 0.9. After the climb has been reached the load factor diminishes. During a loop the instrument indicates, in the upside-down position, 0.6. During slow looping the strain in the upside-down position may become negative. When upside down the weight counteracts the centrifugal force, and hence the stress is small. During the last period of a loop, when coming out of the dive into horizontal flight again, an increase in load is registered. The extent of this increase is proportional to the suddeness of the restoration to normal flight. After a steep dive the stress factor is especially increased. During a side slip, the wing load is diminished. The lift surfaces then do not carry the full weight. Gusts are immediately noticed. Small gusts show momentary indications of 1.2 or more. Strong gusts have been observed during which the indicator shows almost twice the normal stress. An experienced pilot, through careful maneuvers, can reduce the stress by observing the needle during the gusts. As soon as the stress approaches the danger point, the remedy is "downward flight". When upward flight is started, the most natural thing is to ease off. A little easing off is generally sufficient to reduce the stresses.

The scale of the instrument is colored red from the numeral 2 onward. The approach of danger is indicated in the following manner. From the numeral 3 onward the entire sector is colored red. This indicates the immediate aproach of danger. It is advisable in general not to force the stress as indicated beyond 2. The wheel and the indicator of the instrument are shown in the illustration. Only one part of the scale is visible through the sector. The red part of the quadrant is thus generally concealed so as not to cause the pilot anxiety. This color begins to appear on the right border of the quadrant, when the indicator points to 1.3 As long as no red is visible the wing stress needs no special attention. The hand and quadrant of the instrument turn in opposite directions and the range of numerals on the quadrant is from 0.5 to 3.5. The indicator points to a number beyond 1 as long as the pressure acts. The instrument is equipped with a dampener and hence is not sensitive to vibrations of the engine, so that the friction of the instrument does no harm, and the sensitiveness is greater in flight than on the ground.

The indicator is able to measure the wing load through the air pressure without any direct connection with the load sur-

faces. This depends on the following: the airplane as a free moving body must fly on such a curved course that the total air pressure force required to sustain the weight must balance the centrifugal force proportionately. The total effect of weight and centrifugal force—the apparent weight—is measured by the wing load indicator. These forces produce the load value. When the plane is at rest on the ground the instrument shows 1. In order to preserve the instrument, spring suspension is advantageous. While starting and landing the instrument will indicate the landing gear stress. In order to protect the instrument from any damage during the take off, it is equipped (like a compass) with a button which, with a simple turn, opens or closes the instrument.

The uses of this wing load indicator may be summarized as follows: The flight student, especially the advanced one, trains his sense of touch and gains insight into the relation between wing loads and corresponding maneuvers. The indicator makes the work of the instructor easier and increases the understanding of the student. To the stunt flier the instrument is indispensable, when he wishes to get everything possible out of his machine. In this case the instrument serves as a safety device, in that the pilot at a critical moment is not left entirely to his sense of touch. On giant airplanes the responsibility for safeguarding the machine and its cargo justifies every means toward increase of safety. The wing load indicator renders a valuable service in this case. Airplane firms, air travel companies and experiment stations require such an instrument to record the stress during various maneuvers. These data are necessary for establishing strength calculations. In heavy gusts the instrument enables the pilot to spare his machine by proper maneuvers. It makes it possible for him to pull out of a position which is marked as dangerous by the instrument. Finally, the instrument will prove more effective during its operation in the air than when making a theoretical analysis of it at the desk.

## Book Reviews

AUTOMOTIVE IGNITION SYSTEMS. By Earl L. Consoliver and Grover I. Mitchell, of the Mechanical Dept., University of Michigan. (McGraw-Hill Book Co., Inc., New York. 269 pp., 345 ill.)

This is a complete book on automotive ignition, dealing with the systems used on automobiles, trucks, tractors and airplanes. In preparing the text the authors have had in mind the requirements of men who have to install, adjust, and repair ignition systems in the factory and repair shops as well as the needs of the automobile and airplane owner who desires a better understanding of the principles and construction of modern ignition systems. Although there are included in the book a few ignition systems which are no longer manufactured, the great majority of those described are still to be found in operation.

The book is divided into the following chapters: I. Principles of Electricity. II. Ignition Batteries. III. The Jump-Spark Ignition System. IV. Modern Battery Ignition Systems. V. Battery Ignition Systems for Multiple Cylinder Engines. VI. The Low-Tension Magneto. VII. Modern High-Tension Magnetos, Armature Types. VIII. Modern High-Tension Magnetos, Inductor Types. IX. Care and Repair of Ignition Apparatus. X. Ignition Troubles and Remedies.

THE ERECTION AND TRUEING-UP OF AEROPLANES. By F. W. Halliwell, A.F.R.Ae.S., A.M.I.A.E. (St. Martin's Publishing Co., Ltd., 36 Great Queen's St., Kingsway, London, W.C.2 107 pp., 51 ill.)

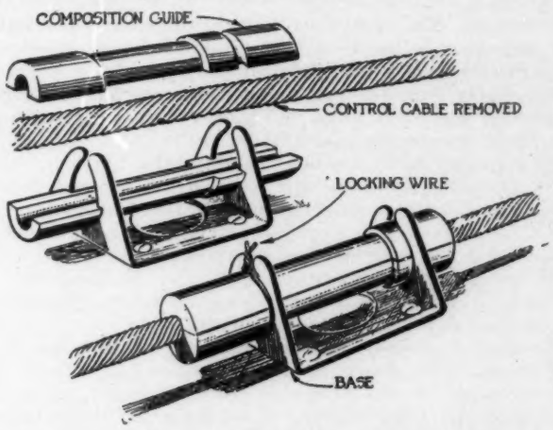
As a result of the war there was evolved a general procedure to be followed in the erection and trueing-up of the orthodox strut-and-wire type of service airplane. This book is a well arranged description of such procedure, written by a man who knows his business. The subject matter is well written and presented in a logical manner, but it does not disclose anything new—even the illustrations being of machines now practically obsolete.

Considering its low price, due to cheap printing and binding ,the book warrants its inclusion in a library so that in the future days of monocoque, cantilever and similar types reference to it may recall memories of what used to be built and flown.

## Detachable Fairleads for Aircraft

A fairlead, in aircraft construction, is a guide and support for the control cables connecting the pilot's levers with the flying control surfaces, or engine spark and throttle levers. Ordinarily these are metal tubes, brazed or soldered to a sheet metal clip for attachment to the aircraft structure, and threaded over the control cable. As such, the fairlead serves to hold the cable in line between pulleys, or to offset the lead to avoid interference with other parts, where the offset is insufficient to render a pulley advisable.

The Williams detachable fairlead, in addition to fullfilling the above functions, permits the cable to be removed or replaced at will. A single fairlead is shown in Fig. 1. It will be




DETACHABLE FAIRLEAD FOR SINGLE CONTROL CABLE

noted that the fairlead comprises a split composition guide held in a metal base, and locked in place by a wire. The method of operation is clearly shown.

Expansion of the number of guides held in a singe base is readily possible, with retention of the detachable feature. A compound base, used for spark and throttle controls on a tandem engine installation is illustrated in Fig. 2. Following are the advantages claimed for this type of fairlead:

1—Control cables can be made up in production prior to the attachment of fairleads, and the fairleads attached to the aircraft structure during construction. 2—The composition guide presents a slow wearing, non-corrosive surface with inherent lubricating qualities to the control cables. Control cable wear is reduced, and in event of wear to the guides, replacement is readily accomplished. 3—Replacement of control cables is facilitated, and erection or tearing down the aircraft can be accomplished with a minimum of work. Replacement cables can be made up complete in the shop, thus avoiding leaving one end open to be made up at the field on assembly. 4—Light weight, standardization and low cost.

According to the inventor, S. T. Williams, of Philadelphia, in one installation where the detachable fairlead replaced an ordinary fairlead, cable life was increased from 18 hours flying time to over one hundred.

In a laboratory test, a fairlead was set up with a 6 in. cable offset in 3 ft., and under a 100 pound pull on a 7 in. stroke, 70 strokes per minute, ran for 75 hours without noticable cable wear. No lubricant was used. The test was discontinued only because the cable was fraying where it passed over a pulley before going onto the fairlead. Though the fairlead was deeply grooved, it was still in condition for many more hours of service.

Ordinarily only two sizes of fairleads are required—one for flying control cables, and one for engine and accessory controls. These have been standardized for the single base mounting. When compound mountings are required, standardized guides are used.—Automotive Industries.

## Chicago-Twin Cities Air Mail

Lack of appropriation of funds by Congress has caused the suspension of the Chicago-Twin Cities route of the Air Mail, but only for the time being it is hoped.

# Experimental Flying Operations in Canada

## *Report Issued by the Air Board, Canada*

*The Air Board of Canada has for some time been conducting experimental flying operations in various sections of the Dominion in order to determine the possible uses of aircraft for civic purposes. The report which follows deals with a series of such experiments which took place in an inaccessible part of British Columbia.*—EDITOR.

### *Air Station Superintendent's Report*

*Foreword.* The operations were instituted for the following purposes.

To demonstrate to the officials of the Dominion and Provincial Forestry Branches the possibilities in aerial transport in connection with their work, and to carry out any experiments along such lines as necessary.

To make an aeriel reconnaisance of the territory within flying radius of Kamloops and Sicamous, and to ascertain the type of machine best suited for work in that locality.

To investigate the effect of atmospheric conditions in mountainous territory on aerial operations.

To test the performance of the H. S. 2. L. flying boat on Lakes at varying altitudes with a view of determining its utility for operations in mountainous territory.

To select a suitable and strategetically situated site for a sub-station in the event of future operations.

*Preliminary Work.* Following the exchange of correspondence with Mr. Cameron, the District Inspector of the Railway Belt, a seat was selected for a temporary base to Carney's Pole Yard on Lake Mara, approximately three miles south of Sicamous.

Work was started dismantling HS-2-L flying boat G-CYBA at Vancouver, and transferring by motor truck a distance of four and a half miles to the C. P. R. freight yards. The hull was shipped over the Canadian National Railways to Basque, thence transferred to the C. P. R. for the balance of the journey. This was necessary as a tunnel on the C. P. R. between Basque and Vancouver did not have sufficient headroom to permit the passage of the carload. The balance of the machine, together with a few spares and sufficient equipment to erect and operate the machine were loaded into an automobile car. This work required three hundred and twenty man hours, and was completed Thursday afternoon, Oct. 26, 1920.

*Operations Party.* The crew selected to carry out the work consisted of one pilot, two engine fitters, two airplane riggers, and one photographer. The party left for Sicamous on the night of Oct. 31.

*Preparations at Base.* Arriving at Sicamous at 11 o'clock Monday morning, Nov. 1., the party proceeded to the site and started preparations for the unloading of the flying material.

The two riggers started unloading the box car, which was already on the siding, and assembling of the wing sections, while the balance of the crew straightened up the poles on the beach, built a runway from the siding down a 9 ft. embankment to the foreshore, and a slipway 90 ft. long for the launching of the machine.

*Unloading.* Early Tuesday morning everything was in readiness for unloading the flat car which had arrived the night before. This hull was hauled down a temporary runway by means of block and tackle to the track level, at the head of the runway leading to the beach.

The contents of the box car were unloaded and the material not immediately in use stored in a tent.

All material was found in good condition, nothing having shifted nor suffered from the journey of 350 miles from Vancouver.

*Erection.* Tuesday afternoon was devoted to the erection. A satisfactory scheme was employed in getting the upper center section into position by using the box car and flat car as working platforms. This obviated the necessity of erecting a jin pole and saved considerable time.

Wednesday morning the crew from the pole yard was borrowed for a few minutes to assist in lifting the assembled wing sections into position and by 3 p. m. the last turn-buckle was locked. The engine was then tested and everything put in readiness for launching Thursday morning. Length of time occupied in unloading, preparing site and assembling—one hundred and eight (108) man hours.

*Launching.* Owing to the flat grade of the beach and the length of the improvised slipway a motor boat was secured to assist in launching the machine. This was accomplished without mishap by noon, and the writer took the machine for a short test flight. Everything was found satisfactory and no alterations necessary.

*Beaching, Dismantling and Loading.* At 12 a. m. Nov 15, the work of beaching and dismantling the machine was started. A team of horses was hired to haul up the slipway and a few extra men were borrowed from the Pole Yard to assist in removing the outer wing panels.

The work proceeded without interruption although climatic conditions were not favorable for work of this nature. Winter weather had set in, and during the two days occupied in dismantling and unloading there was a progression of snow, sleet and rain storms. This work was completed at 12 noon Wednesday and occupied ninety six man hours.

*Cooperation Offered.* Before preceeding to Sicamous to carry out the operations a wire was sent to the Deputy Minister of Lands, Victoria, advising him of the fact that a machine would be operating from Kamloops and Sicamous, and placing at the disposal of the Provincial Government the facilities to carry out any work or experiment desired. A reply was received thanking the writer for the offer and stating that it was considered too late to do anything this season.

*Demonstration Work Accomplished.* Roy Cameron, Chief Forester for B. C., Dominion Forestry Branch, with whom the operations were especially arranged, took the keenest interest in the work, and lent every assistance towards making the experiment as thorough as possible. He not only spent fourteen hours in the air himself making a thorough study of that section of the Railway Belt under his control, and mapping burnt areas, but he arranged for his sub-heads, including his Chief Fire Ranger, Assistant Chief Fire Ranger, Forest Superintendent, and Ranger to make flights and investigate the possibilities in aerial travel. A separate report will be prepared by Mr. Cameron covering the utility of aircraft in connection with his work.

The Provincial District Forester, Mr. Melrose, was taken on two trips some three hundred miles over various types of country. He spoke very highly of the experience and of the value that such aircraft would be to his work. A report along these lines will, no doubt, be prepared by him in due course.

*Suitability of Country for Hydro Aircraft.* The geographical features of the country lend themselves admirably to operations by seaplanes. Especially in the vicinity of Kamloops small lakes are in abundance, while farther east, in the higher ranges, the lakes are larger and much more scattered.

It is considered that a flying boat or pusher type of seaplane with a working ceiling of 10,000 ft. is required to operate safely and efficiently in any part of the country. Such a machine should be capable of attaining this height in the least possible time.

Two types of machines are required:—

(1) A light duty machine capable of carrying two men, fuel for three hours flying, a camera outfit, and 75 lb. of gear.

(2) A heavy duty machine capable of transporting men and fire-fighting material.

*Atmospheric Conditions.* Flying was carried out on fourteen consecutive days regardless of apparent conditions in order to test as thoroughly as possible the behaviour of the machine in bad weather and disturbances from the mountains. No unusual conditions were encountered and at no time did the

machine approach being unmanageable or cause the slightest alarm.

This is quite different to what is generally understood and what might be expected. However, it should not be overlooked that the experiments were carried on in cold weather and that summer heat might cause somewhat different conditions.

*Effect of Mountains.* It might be of interest to note that it was found that the climb of the machine could be considerably accentuated by flying close to the windward side of a mountain. Apparently the wind striking the inclined surface flowed up over the top, the machine benefitting by the up-current.

*Getting off at Altitudes.* Landings and take-offs were made in water aereas up to altitudes of 2,400 ft. above sea level with varying loads. It was intended that tests should be made in lakes at much higher altitudes, but as these were found to be frozen over in many instances and in others partly frozen it was considered abvisable ouly to use such landing places in cases of emergency.

Take-offs were made at Sicamous and Kamloops, which are at an altitude of approximately 1,150 ft. and calm water with four passengers, 136 gal. of gasoline and 120 lb. of gear, without any noticable loss of performance to that at sea level.

Landings and take-offs were made at the 2400 ft. level with three passengers, 85 gall. of gasoline, and 120 lb. of gear with just as satisfactory results. In short it is the opinion of the writer that the change in performance of an H. S. 2. L. getting off water areas up to an altitude of 2,400 ft. is negligible.

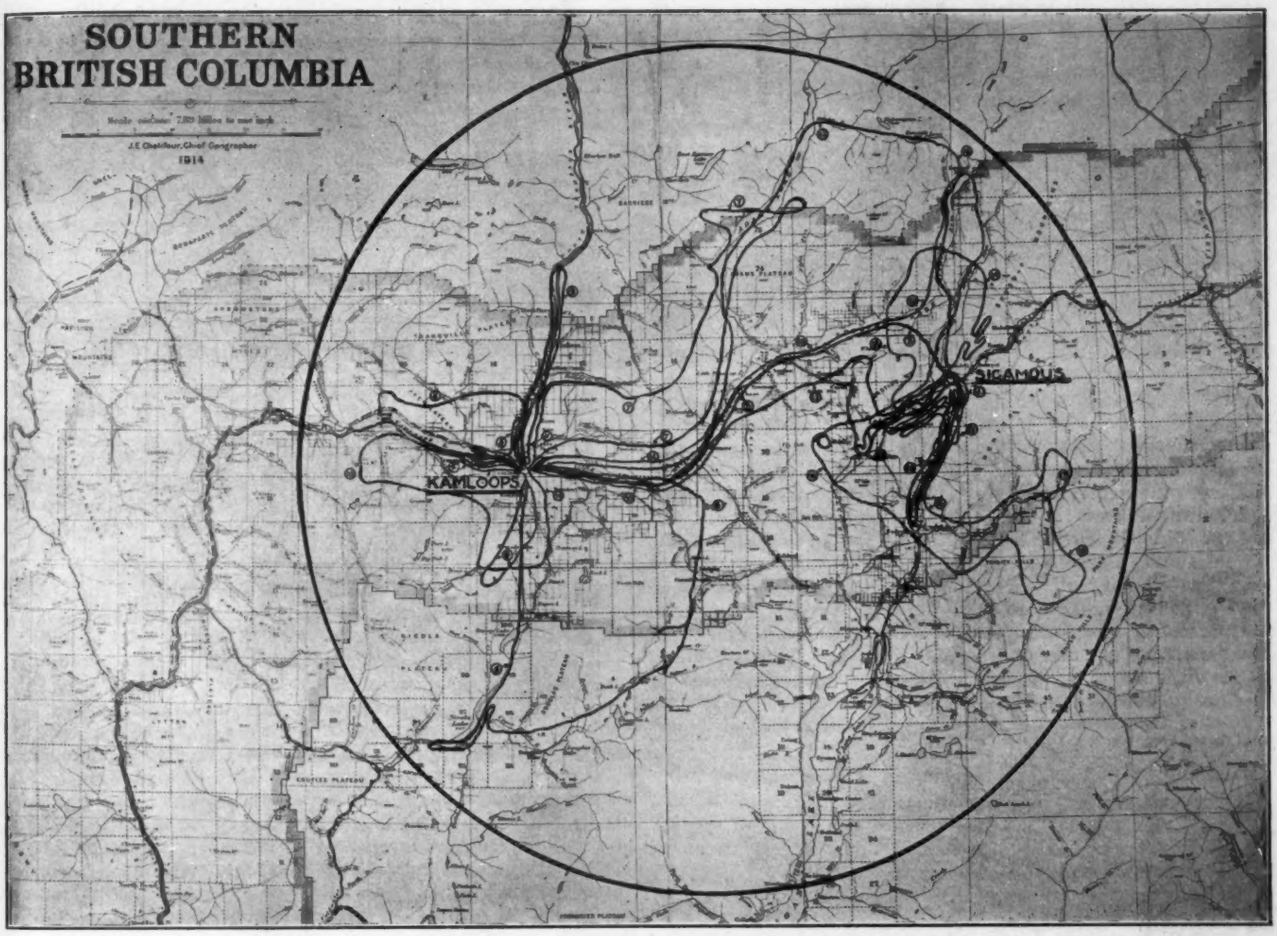
*Recommendations.* The writer is of the opinion that the territory accessible from a base at Kamloops provides a most extensive field for the operations of seaplanes. However, the operations would seem to depend on whether or not the government department requiring the work is in a position to order and pay for it.

If it is decided by the Air Board to establish a base at Kamloops it is recommended, and the attached estimate only provides for a very temporary establishment. This is considered advisable as it is quite possible larger machines will be found useful for particular work in the territory, and the water area available at the site selected may prove too restricted. If such is the case the whole base may be moved to a new site with negligible loss on permanent works. The establishment the writer has in mind, and which would expand as the work increased, would consist of the following:—

One Bessoneau Hangar, partly floored.
One 60x20 ft. sectional hut.
One light temporary slipway, and 12 ft. runway into hangar.
Two H. S. 2. L. flying boats ready for service. (To be reinforced when necessary, from Vancouver).
One air sub-station supt.
One pilot navigator.
Two engine fitters.
Two riggers.

It will be noted that no provision has been made for radio operators or a photographer. It is the opinion that the want of the former will not be sufficient to warrent their inclusion in the establishment for the present, while the latter may be sent up from Vancouver when a particular photographic reconnaissance is to be made.

In the event of operations being instituted from Kamloops next spring the writer would suggest that an F. 3. be attached to the base for a period to test the suitability and advisability of operating a large machine in such mountainous and broken




Map of Area of Operations (in Circle) Showing Temporary Flying Bases at Kamloops and Sicamous, and Patrols Emanating Respectively from each Base

country. The services of a large machine would be very valuable in the case of transferring men and fire-fighting material to fires in parts of the country not now served by roads and inaccessible by motor boat.

*Equipment.* Although the operations did not suffer for lack of equipment it is recommended that in carrying out similar operations in the future that the following should be included in the outfit whenever possible:—

1—Row boat fitted with Evenrude Motor.
—Mooring complete with chain and anchor.
50—ft. of 1¼ in. hose for syphoning petrol.
1—Large tool box where all removable gear may be securely locked up.
Complete camping outfit for personnel.

*G—CYBA and Liberty Motor.* Too much cannot be said in praise for the behavior of the machine and engine during the operations. Not the slightest inconvenience or delay was occasioned at any time by any fault in the machine or engine. Although the weather was very cold and the machine anchored out continually not the least trouble was experienced in starting the engine or during flight. I might say that the engine did not miss an explosion during the 22¾ hr. flying. After the first flight it was noticed that on account of the cold weather the engine was running too cold. This was corrected by screening off one fifth of the radiator surface. The wind driven petrol pump had a tendency to seize up in the cold weather due to the oil freezing. This was overcome by lubricating with a mixture of oil and kerosene.

*Cost of Operations and Notes.* The following is a condensed statement of expenses:

| | |
|---|---|
| Dismantling and loading machine at Vancouver. | |
| Foreman, truck driver and nine men. (320 man hours) | $187.84 |
| Freight on two cars to Sicamous, | 604.50 |
| Freight on petrol to Kamloops & Sicamous, | 53.00 |
| Transportation for six men to Sicamous, | 111.25 |
| Transportation for men between Kamloops & Sicamous | 20.70 |
| Salaries for Pilot, Photographer, and four men (17 days), | 485.00 |
| Cost of gasoline consumed 495 Imp. Gals. at 50c, | 247.50 |
| Cost of oil consumed 22 Gals. at $1.50, | 33.00 |
| Board and lodging at Kamloops and Sicamous | 356.90 |
| Incidental expenses, | 87.15 |
| Freight on two cars to Vancouver, | 604.50 |
| Transportation for six men to Vancouver, | 111.25 |
| Unloading and re-erecting at Vancouver, Estimated 150 man hours, | 85.50 |
| Total Cost | $2988.09 |

### *Part II. Extracts from District Forest Inspector's Report*

*Extract from Report of Flights Undertaken*—Nov. 7 On Monday, the 7th, a trip was mapped out to cross the Niskonlith Reserve south of Tod Mountain to Adams Lake thence over the operations of the Adams River Lumber Company in the vicinity of Johnson Lake at the extreme end of the Niskonlith Forest Reserve, thence across the plateau between Adams Lake and the north fork of Scotch Creek. During the trip we attained an altitude of 7,700 ft. above sea level. My object in making this trip was, first, to have a look at the country in the vicinity of Hyas Long Lake, which is the ultimate watershed of the tributaries draining into Paul Lake, and for which territory we have received a request that the timber be burned off. I was able to get a very fair idea not only of the general nature of the country of this watershed, but also of the timber conditions and the danger of erosion following denudation. The flight route passed along the edge of and over the great body of green timber lying south and east of Tod Mountain. This was my first opportunity to inspect from the air any extent of green timber, and I was amazed at the detail it was possible to cover from the study allowed by a single flight over the territory. There was no difficulty in distinguishing specimens of tree species on the ground as they presented marked characteristics when viewed from the air. The timber on this area, and other areas examined the same day, consists of different species including Douglas Fir, Yellow Pine, Lodgepole Pine, Western White Pine, Western Cedar, Western Hemlock, Engleman Spruce and Alpine Fir. The characteristics of each of these species can be identified largely by the form of crown and color of foliage. After lunch we headed north and over the operations of the Adams River Lumber Company and the timber lying on the boundary of the Niskonlith Reserve. The scheme of development and the possible development of operations in that vicinity, which involves fluming from an altitude of 4,000 ft. into Adams Lake at an altitude of 1,300 ft., can be grasped in detail in a few minutes from the airplane; which leads me to believe that the use of airplanes would be valuable to executives of lumber companies or their wood superintendents in planning the undertaking operations in a mountainous country. Leaving these operations we headed east across Adams Lake at an altitude of 7000 ft., the timber situated in Township 25, Range 2, west of the 6th M. I had previously made a trip into this timber and understood that there was a considerable quantity, but I never before realized the extent and unbroken body of timber in this region, which occurs not only in the railway belt, but extends for miles into the provincial lands. It is perhaps the biggest solid block of green timber now existing in the interior at any rate adjacent to the railway belt. From what was seen during this flight, there could not be less than one billion feet in this region.

Panoramic View of the Flying Base on Lake Mara, Near Sicamcus, B. C.

*Extract from Patrol—November 12th.* Mr. Smart, Acting Chief Fire Ranger of the Salmon Arm District, accompanied by Major MacLaurin, and myself flew over Notch Hill, thence to White Lake and through the divide between that Lake and part of the Shuswap lying across from the station of Canoe on the Canadian Pacific Railway. This divide is really a low pass into the Bastion Mountains and constitutes the locality wherein occurred one of the most serious fires encountered last season. The results of the observations gained on these fires were very enlightening from several points of view. First, Mr. Smart, who directed the general campaign, was able to see to his own satisfaction that not only were the points of attack or resistance to the fire chosen by himself the proper ones, but that these points had been satisfactorily held in every case, and the damage done restricted to a very small percentage of the loss that would have been incurred in the vicinity of White

Lake had the attack been less strenuous or concentrated. It was also ascertained that by far the greater portion of timber in this watershed is still unharmed and that there is a great body of timber requiring protection. Passing east along the south face of the Bastion Mountains, several small fires were noticed, which had not been known or mapped owing to their having occurred at a time when a smoke pall covered the whole country.

Nov. 13, Sub-Chief Fire Ranger, Mobley, made a flight along the north face of the Bastion Mountains, Westward to White Lake, for the purpose of mapping in the north west Boundary of the fire, which had not been secured in detail in the flight of the day before. During this flight a reconnaissance of the plateau country lying between the gorge of Eagle River and Shuswap Lake was made. This is a very high and inacessible country, without trails, and practically unexplored by any officer of this service. The opening up of this country by a trail from a point in the lower Eagle Valley to the summit of Qu'est Mountain is under consideration. The important features in looking at this trail was to ascertain, first the possible ways to ascend from the rim rock forming the north face of the Eagle Valley, and second, the location of the trail on the plateau so as to provide the greatest protection with the best grades and the least expense. This flight showed us that there was but one possible route for this trail to get any kind of grade out of Eagle Valley, and furthermore, that this route would bring us directly into the best of the timber on the plateau, which really comprises a series of high ridges rolling up towards Qu'est Mountain. These ridges are interspersed by high shallow valleys containing great quantities of heavy green timber, consisting of Cedar, Douglas Fir, White Pine and towards the higher portion, Engleman Spruce and Alpine Fir.

*Possible Uses of Seaplane in Forest Administration British Columbia Inspection District.* The general nature of the work which it is considered feasible to handle from the air may be considered under the main heads as follows:—1. Silviculture. 2. Grazing. 3. Protection. 4. Uses. 5. Administration.

Silviculture (a) Exploration and sketch mapping of timber areas in inaccessible locations.

The value of aerial reconnaissance will lie in the perfecting of the protection system as a result of the information obtained and the planning of further improvements necessary, from fundamental data which would not be available otherwise.

(b) Photographic reconnaissance.

I am uninformed with regard to experiments and work of this nature. Reference is made, however, to the article dealing with this subject by Mr. Elwood Wilson in the October number of the Canadian Forestry Magazine. If results can be obtained in this province to a degree comparable to those obtained in Quebec a photographic reconnaissance from the air would be the logical method of stock-taking.

(c) Investigation and Exploration of Insect Infestation Aerial reconnaissance will be valuable in scouting for new infestation, checking up the progress of old ones, and operating in connection with their control.

(d) Observation flights for intending applicants of large timber sales.

In view of the probable early development of the pulp industry in this province and the fact that inquiries are being made in this district with reference to pulp wood areas, including the correlative question of water power, driveability of streams, etc., it is possible that the use of seaplanes may be a deciding factor in interesting capital and inaugurating developments along these lines.

Grazing (a) Exploratory and sketch mapping of nature and extent of forest range.

(b) Photographic grazing reconnaissance.

This work could be correlated with the timber reconnaissance mentioned above.

(c) Grazing patrols.

1. To check up conditions of the forest range in the spring, and to determine the date on which range conditions will be far enough advanced to permit access of stock thereto.

2. To determine the use being made on range by Permittees, with special reference to the rotation of pasture throughout the allotment.

3. Checking up of trespass, especially with reference to the use of cattle range by sheep and vice versa.

Protection (a) observation of possible and most desirable trail location with respect to timber, topography etc. The value of this work was demonstrated during the experimental flights this Fall.

(b) Fire Patrols. Detection of forest fires during high hazard season.

(c) Initial and Progress Report on fires with special reference to lightning fires occurring in inaccessible localities.

Progress reports and actual observation by fire bosses would determine the best methods and points of attack which must be varied to meet emergencies resulting from adverse weather conditions, topography, and timber conditions in the path of the flames. This feature of the seaplane work alone would be worth the cost of operations for the whole season in such a year as last, if not with respect to actual money saved in fire fighting, at any rate with reference to valuable timber saved from destruction.

(d) Emergency Transportation. First, transportation of fire bosses, chief rangers, etc., from fire to fire for the purpose of guaging the general situation. Second, transportation, where feasible, of men, equipment and supplies. Critical points last summer were focused in localities in which seaplanes could have operated with the utmost ease.

(e) Periodic patrols on coast district. Necessary on account of week end migration of city residents for the purpose of camping or fishing. During each week end there is an outbreak of camp fires which the utmost work of our staff sometimes fails to cope with. Owing to the extent of country to be covered it is impossible for our rangers to patrol the entire area frequented by these people within the time required for proper protection. It is thought that the psychological effect and general publicity which would be created by a seaplane patrol in this region would have an extremely far reaching effect.

(f) Check mapping of burned areas of large fires in inaccessible locations.

Uses (a) Mapping or photographing administrative states, project meadows, etc. This would probably do away with the somewhat costly survey of project meadows by metes and bounds at present required.

(b) Restocking Lakes. The seaplane affords an ideal method of transporting fish eggs or small fry for purposes of stocking or restocking.

Administration.

(a) Transportation of senior forest officers during emergency periods.

(b) Observation flights for visiting Foresters or Head Office Staff to show general nature of country or operations under way.

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## The Gabriele D'Annunzio Cup

The International Aviation Meet for the Gabriele D'Annunzio cup will take place on Lake Garda during ten days in September, the date of beginning not yet having been announced.

Prizes to the amount of Lire 100,000 will be awarded.

General Regulations: The meet is restricted to contestants belonging to the late Allied or neutral countries.

The competition will be carried out in accordance with the "General Regulations of the International Aeronautic Federation" and the regulations of the "Italian National Aeronautic Federation" (The Aero Club of Italy).

The prizes will be awarded as follows: For the motor-boat races cash prizes amounting to Lire 50,000, and for the seaplane races cash prizes amounting to Lire 30,000 and the Gabriele D'Annunzio cup valued at Lire 20,000.

Qualifications and Entries: The defination of seaplanes as stated in the regulations of the Monaco Aviation Meet has been adopted. The types of seaplanes which may enter the contest are as follows: First Series, Weight-carrying seaplanes, Schneider Cup type, carrying 200 kg. of commercial load. Second Series, speed seaplanes, Monaco type, with no commercial load.

All entries must be accompanied by an entrance fee of Lire 200. Entries will be received by the Entry Committee, Lake Garda, Italy.

## Furnace for Heat Treating Duralumin

Fred Keller

While preparing to make a series of tests to determine the effect of heat treatment and ageing upon duralumin it became necessary to construct an efficient and inexpensive muffle furnace to heat treat the specimens. The desirable feature was to have a muffle which could be heated up quickly and with which a uniform temperature could be maintained.

In studying the various types of muffles in use, it was decided that the most efficient and inexpensive method was to construct a muffle inclosed crucible such as has been used very successfully by a number of metallurgists in the study of alloys for obtaining cooling curves. The muffle was constructed of sheet steel in the shape of an inverted truncated cone and was raised from the surface of the work bench by a tripod arrangement of three legs spot-welded to the body. The outside of the muffle was covered with sheet asbestos to retain the heat. The crucible was made of a three inch gas pipe having a 1/8 in. wall, and with a bottom welded on. At the top of the crucible were welded three lugs by which it was suspended from the top of the muffle. The heat was furnished by a single Bunsen burner and a temperature of 900 deg. was easily reached in about 20 minutes.

The thermo couple of the pyrometer and the test specimens were inserted side by side in the solution in the crucible which was composed of half and half Sodium and Potassium Nitrate. The solution being at the desired temperature the treatment was continued the proper length of time. The temperature was accurately recorded and was uniform the depth of the solution. In order to test this a number of samples were sclerescoped along their entire length and the average of as many as 30 readings did not vary to any great extent from the results of a single reading.

The arrangement described has been used in the laboratory for the past six months and has given excellent service and uniform results have been obtained at all times.

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## Aviation in Japan

The following is a resumé of aviation in Japan, released by the British Air Ministry:—

"It is not the intention of the Japanese government to concentrate its attention on military aviation to the neglect of civil aviation. The army will start this year to train workmen in order to promote the manufacture of aircraft by private concerns. It will also train civil pilots. Though as yet the preference has been given to military aviation in order to meet urgent military requirements, Japan is now taking steps with a view to having military and civil aviation services develop side by side. It must be pointed out that civil airplanes are of a different nature from military ones, because civil flying machines are intended chiefly for transport. Workshops for civil airplanes can be made use of both by the army and navy, but as for civil planes themselves, it is extremely difficult to employ them for military purposes. It will be exceedingly convenient if in time of war the entire capacity of civil workshops can be used for military purposes. As regards the organ for the unification of aviation administration and for establishing connection between military and civil aviation enterprises, the Aviation Bureau has charge of all affairs relating to aviation with the exception of military aviation. As military and naval officers are also among the personnel of this Bureau, closest connection is established between civil and military aviation.

"The Aviation Bureau is now engaged in investigations preliminary to the establishment of routes. As regards landing places, mentioned by Baron Togo, these being equivalent to ports, it is proper that they should be provided by the government. When aerial routes are fixed and suitable arrangements for landing places are devised, it is thought that the establishment of landing places in certain towns on aerial routes will follow as a natural consequence, and they will, in their turn, be followed by the establishment of private landing places. The Aviation Bureau has despatched five detachments to make investigations connected with aerial routes, but as they have to go over extensive tracts of land, the work cannot be finished in a short time. When they return, aerial routes will be marked on the basis of their reports."

## Postponement of Detroit Air Meet

The Detroit Aviation Society under whose auspices the Detroit air races were to be held has issued a statement in explanation of the postponment. In part it says:

In the firm belief that we had the full co-operation and support of the Army and Navy in the running of a big serial race meet this fall, the Detroit Aviation Society, Inc. was organized, and a great deal of good work done by its Officers, Directors, Committee Chairmen and members. There was never any question but that the races were desired by both Air Services as a very valuable means of stimulating engineering and making comparative tests under strenuous conditions of the best types of both Army and Navy equipment.

The first inkling of doubt about Government entries came about June 11th, in the form of a rumor that the Secretary of War had ordered the Army not to participate. It was not, however, until practically June 20th that we had definite advice from the Army Air Service that their participation had been denied by the Secretary of War, but stating that the same request for authority might be resubmitted July 1st, after the Army Appropriation Bill had been passed.

A day or two later we received a very encouraging letter from the Navy Department, under date of June 25th, signed by Captain Moffett, indicating that the Navy was considering the entry of nine (9) machines.

On Friday, July 1st, Harold Emmons, Council for the Detroit Aviation Society, Inc. called on representatives of the Army and Navy but could obtain no definite committal from either Department. The impression he gained was that the matter would not be definitely decided for another ten days.

On July 14th, Harold H. Emmons and Sidney D. Waldon had interviews with the Air Services of both Army and Navy, as well as interviews with the Secretaries of War and Navy. It was apparent on this date that while the Air Service Officers themselves were keen for the holding of the Air Meet, that the Secretaries were inclined to deny the authority and funds.

At the close of the interview with Secretary Weeks late in the afternoon of July 14th, he agreed to call Major General Monoher into conference the first thing Friday morning; that he would also take up the matter with the Secretary of the Navy, before or after a Cabinet Meeting at noon, and that he would give an answer for both at 5:00 o'clock Friday afternoon.

Secretary Weeks was seen Friday evening, and his decision was that in view of the urgent necessity for economies in all branches of the Government—(and particularly in view of the shortage of certain appropriations affecting the Army Air Service)—that neither the Army nor the Navy would participate in these races this year.

We endeavored to make clear to both Secretaries the obligation that we owed to every worker and contributor to this project—that we were undertaking it for the advancement of the science of Aviation and in no wise for personal gain—and that both the Army and Navy and ourselves owed quite an obligation to those same workers and contributors to hold the event as early next year as would be most satisfactory to the Army and Navy.

It is with very deep regret that our Air Meet must be postponed to next summer.

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## Pacific Standard Model Cl

A new type of airplane made its appearance at the International Air Tournament held at the Los Angeles Speedway July 16th and 17th. The feature race of this tournament was the Curtiss Cup Race open to planes equipped with a Curtiss OX-5 engine which were required to pass an elimination trial of 100 m. p. h.

The Pacific Airplane & Supply Co. entered in this event a Pacific Standard Model Cl, which is a cantilever monoplane using a modified U. S. A. 27 wing curve. This machine which has a span of 23 ft. 3 in., a length over all of 20 ft. 6 in., weighs 1140 lb. fully loaded, and succeeded in winning the Curtiss Cup race at a speed of 105 m. p. h. on a 20 mile hair pin course around pylons situated one mile apart.

# The Royal Air Force Pageant

For some years there have been held in Great Britain annual displays by the army and navy. Since the Royal Air Force has been made a service in itself on a par with the army and navy there has been an annual Royal Air Force pageant. This is nothing more or less than a scheme to show service flying to the public. The receipts from the pageant go towards the maintenance of the Royal Air Force Memorial Fund.

This year's pageant was held on July 2 at Hendon Airdrome, London, The organization and quality of the flying displayed were all that they should be at such an affair. From the types of machines and engines demonstrated and the calibre of the flying done by their pilots no doubt remains that the R. A. F. still maintains the mastery it gained during the late war.

The events were run off as scheduled, trumpeters announcing each, and automobiles mounting numbered placards of the event touring within view of the spectators. It is noteworthy that such of the latter as were in the immediate vicinity of the airdrome were so located that machines taking off did not pass directly over them. The number of spectators has been variously estimated but no definite figure decided upon as they were spread over the country for miles in the neighborhood of the airdrome. The airship R33 was an interested spectator, and by her presence added to the completeness of the pageant.

During the morning the preliminary heats of the squadron relay race were flown. Each team consisted of an Avro (110 hp. Rhone), a Bristol Fighter (275 hp. Rolls Royce), and a Sopwith Snipe (200 hp. Bentley). The Avros flew first starting on signal previous to which their engines were still. The Bristols followed and then the Snipes. A message was relayed by the passenger of the machine landing to the one taking off.

After an interval for lunch the afternoon program was begun. The first event was a 12-mile handicap in which eight different types of airplanes took part. The machines, starting order, and handicaps were as follows:

| Machine | Starting Order | Handicap m. s. |
|---|---|---|
| Handley Page (0.400) (2,275 hp. RR.) | 1 | 5 3 |
| Avro (110 hp. Rhone) ..... | 2 | 3 47 |
| Bristol Fighter (275 hp. RR.) ..... | 3 | 1 9.40 |
| Sopwith Snipe (200 hp. Bentley) .... | 4 | 1 1 |
| D H 9A (Liberty 400 hp.) ..... | 5 | 0 56.20 |
| S. E. 5 (200 hp. Hispano Suiza) .... | 6 | 0 47 |
| B. A. T. (200 hp. A. B. C.) ..... | 7 | 0 29 |
| Nieuport Nighthawk (325 hp. A. B. C.) | 8 | Scratch |

The winner of this race was the Snipe in 5 min. 15 sec. The DH9A was second in 9 min. 18 sec., and the Nighthawk third two seconds later.

The second event was a combat between a Bristol Fighter (275 hp. RR.) and two Sopwith Snipes (200 hp. Bentley). The combat finished when one Snipe went down apparently out of control and the Bristol, hit, spiralled down emitting a stream of smoke as a result of an attack by the remaining Snipe.

The third event was a race for Avros (100 hp. Rhone), the training machine of the R.A.F., for a cup presented by Maj. Gen. J. E. B. Seely a former Under-Secretary of State for Air. The race began with the signal for starting the engines, and thus the success of the machines depended on both the pilot and the mechanics. Fourteen machines representing as many different air stations competed.

The fourth event was an exhibition of flying by Flying Officer P. W. S. Bulman M.C., A.F.C. on a Bat (200 hp. A. B. C.). The speed and maneuverability of this product of Mr. Koollhoven's brain is remarkable and was shown off to excellent advantage by the skillful piloting of Flying Officer Bulman.

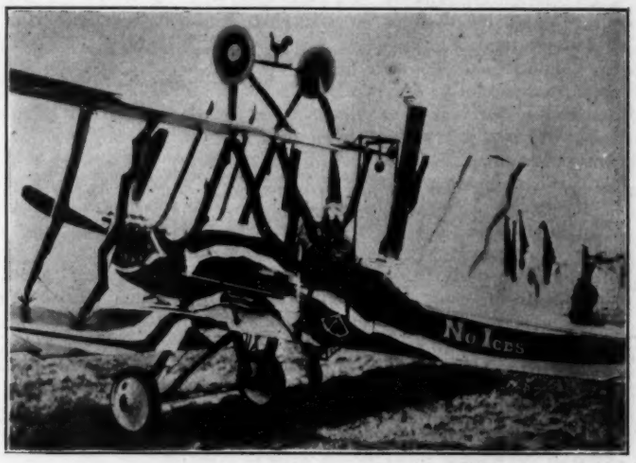
Following this five Snipes lead by Squadron Leader C. Draper D.S.C. gave a remarkable display of acrobatic formation flying. They took off in formation after each stunt and landed in formation. Their finest stunt was upside down flying out of the top of a loop.

The sixth event was another aerial combat, this time between a Nieuport Nighthawk (Siddeley Static Radial 300 hp.) and a Siddeley Siskin (same engine). The machines and pilots were well matched and gave an interesting display.

More formation flying followed, the machines being nine Bristol Fighters. They took off in formation and gave a striking exhibition of formation flying as it should be done. Particularly good was the demonstration of three formations of three machines. The leader fired a rocket and the formations broke up as if for a dog fight, reforming on a second signal.

The eighth event was an exhibition of stunt flying by Flight Lieutenant W. H. Longton on a Camel. The feature of Flight Lieutenant Longton's flying was the wonderfully uniform speed at which he stunted the Camel.

An attack on a formation of three Handley Pages (2 Rolls Royce 275 hp.) by five Sopwith Snipes was the next event.




THE SPECIAL BE-2 WHICH WAS THE COMIC FEATURE OF THE R.A.F. PAGEANT AT HENDON

*Photo International*

Two of the H.P.'s were sent down in "flames", the third escaping only to have one of the crew jump to safety using three successive parachutes.

Following this came a demonstration of a Jazz machine—an old B.E. fitted with a funnel, complete, with smoke; an under carriage on the top plane; a clothes line; et al.

The eleventh event was the final of the Avro, Bristol, Snipe relay race described above.

The next event was a remarkable demonstration of how-not-to-fly by Flight Lieutenant J. Noakes, A.F.C., M.M., on an Avro painted red. Flight Lieutenant Noakes was a sergeant pilot with the late Major McCudden V.C., D.S.O.M.C., M.M. etc. in 26 Squadron, R.F.C. on D.H. 2s. His piloting of these was understood after he was seen on the Avro in an assortment of flat turns, stalls, and what nots.

An attack on, and the destruction of, a kite balloon by a formation of Snipes followed.

The fourteenth and last event was the bombing of a village by a formation of Bristol Fighters. The bombing was followed by an infantry attack under cover of a smoke screen laid from a Handley Page.

Altogether the pageant was a great success. A notable feature of the flying being only one forced landing; and this machine later returned to the airdrome, The public undoubtedly received an impressive idea of what the Royal Air Force is prepared to do in the event of necessity.

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### French Height Record

Kirch is reported to have reached a height of 32,889 ft. above Versailles on June 26th, using a biplane with a 300 hp. motor, beating the record held by Casale who flew to a height of 31,216 ft. in June 1919.

## Fokker to Build American Planes

Coincident with the arrival at Hazelhurst Field, L. I., of the Fokker limousine, five passenger, monoplane comes the announcement that the Netherlands Aircraft Manufacturing Co. of Amsterdam and New York will soon commence manufacturing Fokker machines of all types in this country. The limousine which is known as the Fokker F III will be demonstrated by Bert Acosta, who is test pilot for the Dutch company. Anthony H. G. Fokker said when he visited this country recently that he regarded the United States as the most fertile field for aircraft exploitation, and signified his intention of manufacturing here as soon as his European contracts would permit. The limousine is the first machine he has sent here to make good his promise.

R. B. C. Noorduyn who, with F. Cremer is representing the Netherlands interests here, said that the limousine is one of the highest developments of the passenger-carrying airplane now in use in Europe.

Its design emphasizes the fact that war machines are not adaptible to commercial use, and Mr. Fokker was one of the first to understand this. The war machine, of which there are thousands in Europe, is too expensive and to dangerous to operate commercially. The war machines are about as useful for commercial air transportation as a battle ship would be when converted into a trans-Atlantic liner. Realizing that the operating costs must be reduced to a minimum and the useful load increased as much as possible, Mr. Fokker as soon as the war ended designed commercial airplanes. The limousine now at Hazelhurst Field is a high development in the passenger-carrying machine. It will carry, in addition to the pilot, and fuel sufficient for more than 4 hr. flight, five passengers and their luggage or, instead, more than 1000 lb. of freight. With an engine of only 220 h. p. and a fuel consumption of about 12 gall. of gasoline an hour, this machine will maintain an average speed of 105 m. p. h. The cabin is very roomy and seats 5 passengers. It is upholstered on the sides and ceiling, and the floor is carpeted. There are three windows on each side, two of which may be opened, and the temperature of the cabin is regulated so as to be always comfortable, no matter how hot or cold it may be outside.

Since the arrival of the "Half Moon", as this particular machine is called, at Curtiss Field several test and passenger flights have been made by pilot Bert Acosta who has expressed himself as favorably impressed by the smooth running of the engine and the ease of controllability and good visibility of the machine.

Arrangements have been made by the officials of the Netherlands Co. for a series of flights out of New York. One of the first of these will be a non-stop trip to Washington, where the machine will be demonstrated for the benefit of government officials. It is expected that the manufacture of Fokker machines by American mechanics from materials obtained in this country, will commence early this fall.

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## Airdrome Notes

### Houston, Texas

Flying will shortly be resumed at Ellington Field with the arrival of five Air Service squadrons from Kelly Field. For some time Ellington Field has been practically dormant, being only used as a supply depot of the neighboring fields.

### Middletown, Pa.

A large addition is planned to the air depot here, approval having been obtained for the purchase of 320 acres of ground north of the city. The air depot will then be extended to include the buildings and ground of the present ordnance depot which is to be abandoned.

### Omaha, Neb.

At a recent meeting of the Omaha Aero Club a drive was started to raise funds for the promotion of an aerial meet at Fort Crook airdrome in November.


## Where to Fly

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SAN FRANCISCO, CALIFORNIA
**EARL P. COOPER AIRPLANE & MOTOR CO.**

*ILLINOIS*
**CHECKERBOARD AIRPLANE SERVICE**
FOREST PARK, ILLINOIS

*INDIANIA*
*One of the largest and best equipped flying fields in the United States.*
**CURTISS-INDIANA COMPANY**
Kokomo, Indiana
ALL TYPES OF CURTISS PLANES.

*LOUISIANA*
**GULF STATES AIRCRAFT COMPANY**
SHREVEPORT, LA.

*MASSACHUSETTS*
BOSTON AND SPRINGFIELD, MASS.
**EASTERN AIRCRAFT CORP.**
340 FIRST ST., BOSTON, MASS.

*MINNESOTA*
***WHITE BEAR LAKE, MINN.***
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**Harold G. Peterson Aircraft Company**
SCHOOL OF AVIATION

*NEW YORK*
**AEROMARINE AIRWAYS, INC.**
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11 Passenger Flying Cruisers -- 5 passenger, open and enclosed Flying Boats. Sightseeing Tours - Flights to Shore and Lake Resorts

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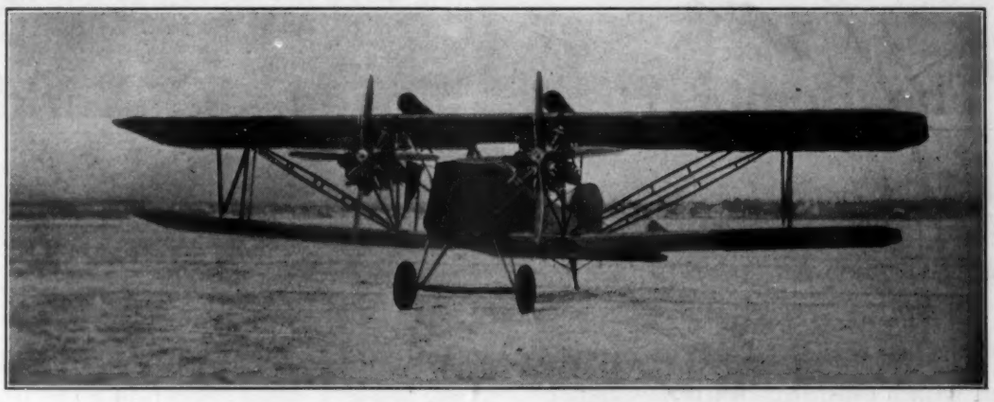

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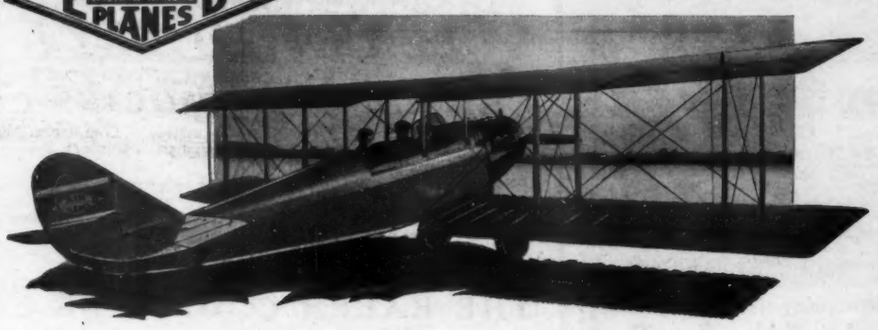


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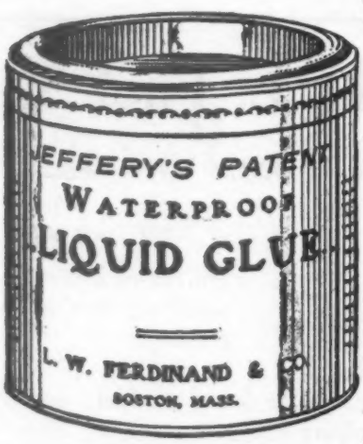


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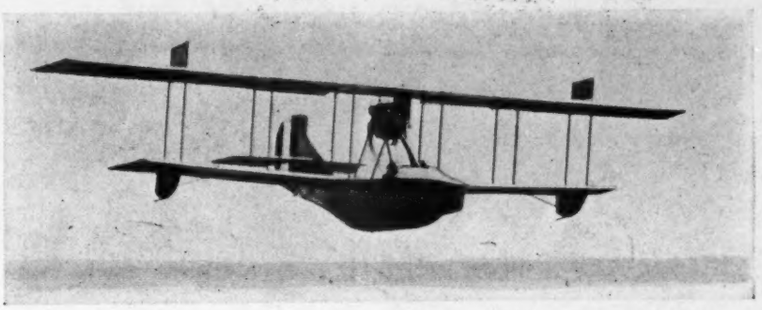

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